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ZOOLOGICAL EXPEDITIONS TO THE KRAKATAU ISLANDS, 1984 AND 1985: ODONATA

Descriptions and records of Malesian Odonata, 2

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A list of the Odonata collected by the members of the Krakatau Expeditions (1984 and 1985), organized by the La Trobe University (Melbourne) and LIPI (Jakarta). Most of the species mentioned are not from the Krakatau Islands, but from westernmost Java (Jawa) or southernmost Sumatra (Sumatera). *Agriocnemis pygmaea* (Rambur) and *Orthetrum t. testaceum* (Burmeister) are recorded from the Krakatau Islands for the first time.

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Key words. – Odonata; Malesia; Krakatau; Java; Sumatra.

Members of most entomological expeditions to the Krakataus have made collections of dragonflies (Odonata). Yukawa & Yamane (1985) recently summarized the present knowledge. Their list of references should be completed with the work of Ris (1912), since that publication provides the identifications of the specimens collected by Jacobson in May 1908, and only referred to as 'spec. 1' and 'spec. 2' by Jacobson (1909). Thornton & New (1988b) gave some preliminary results of the present material and some sight observations.

The present collection of Odonata includes considerably more species, mainly due to sampling activities in the southernmost part of Sumatra and the westernmost part of Java. A detailed account of the general results of these expeditions were given by Thornton and Rosengren (1988), while Thornton & New (1988a) deal with the freshwater communities. Presently, the only known relatively permanent water bodies on the Krakatau Islands are concrete-lined ponds, one on Sertung and two on northern Panjang. Before 1940 there were several pools and a brackish-water lake with breeding populations of eurytopic Odonata, e.g. *Pseudagrion microcephalum* (Rambur), *Ischnura senegalensis* (Rambur), *Diplacodes trivialis* (Rambur) and *Pantala flavescens* (Fabricius) (Dammerman 1948).

The following systematic account lists all species collected during the expeditions of 1984 and 1985. Species collected on the Krakatau islands Rakata, Sertung, Anak Krakatau or Panjang are marked with an asterisk. All records are given in full, but data on longitude-latitude are summarized in the next paragraph.

LOCALITIES

Sumatra. – Liwa (1), sweeping, 5°04'S 104°03'E; Liwa (2), secondary forest, sweeping, 700 m, 5°04'S 104°03'E; Liwa (4), 5°04'S 104°03'E.

Krakatau Islands. – Rakata, Owl Bay, 6°09'S 105°28'E; Panjang, 6°05'S 105°28'E; Anak Krakatau, sweeping, 6°06'S 105°26'E; Sertung, forest, 6°05'S 105°23'E; Sertung, Spit, 6°04'S 105°24'-25'E.

Java. – Ujung Kulon, Pulau Peucang, 6°45'S 105°15'E; Ujung Kulon, Cideon, 6°46'S 105°15'E; Ujung Kulon, Cibunar, 6°48'S 105°17'E; Hills behind Carita.

The present and former names of the islands are: Rakata, also known as Rakata Besar and Krakatau; Panjang, also known as Rakata Kecil and Lang eiland; Sertung, also known as Verlaten eiland. Compilation of information on topography and the history of events are to be found in Dammerman (1948), and the more recently published works of Simkin & Fiske (1983) and Thornton & Rosengren (1988).

SYSTEMATIC LIST

The systematic list follows Davies & Tobin (1984, 1985). Records for each species are arranged in chronological order. Short comments on distribution and abundance of the species are given, usually based on Lieftinck's publications (Lieftinck 1934, 1935, 1953 and 1954) and the RMNH collection, Leiden. Special attention was paid to notes giving details about occurrence in southern Sumatra and western Java. Especially Lieftinck's records of 'Mt Tanggamoes' [= Gunung Tanggamus] are of great interest for the interpretation of the observations from Liwa. The status of Odonata before 1940 is well established through many collecting trips of entomologists working for the Bogor museum (formerly Buitenzorg).

Abbreviations used: RMNH = National Museum of Natural History, Leiden.

Family Amphipterygidae

Devadatta argyoides (Selys, 1859)

Sumatra, Liwa (2), 191 BB, 1 Sep 1984, 1 female.

Although generally uncommon, it was very abundant in the Gn Tanggamus area in December 1934 (Lieftinck 1935).

Family Calopterygidae

Neurobasis chinensis chinensis (Linnaeus, 1758) (fig. 1)

Sumatra, Liwa (2), 191 BD, 1 Sep 1984, 1 male; Idem, 191-BA, 1 female.

The nominal subspecies is common on Sumatra, including the southernmost part. Javanese populations are ranked as a separate subspecies, *N. chinensis florida* Hagen.

Vestalis luctuosa (Burmeister, 1839)

Sumatra, Liwa (2), 191 BC, 1 male.

Java, Ujung Kulon, Cidaon, 190 GA and 190 HC, 15 Sep 1984, 1 male, 1 female; Idem, 190 ND, 16 Sep 1984, 1 male.

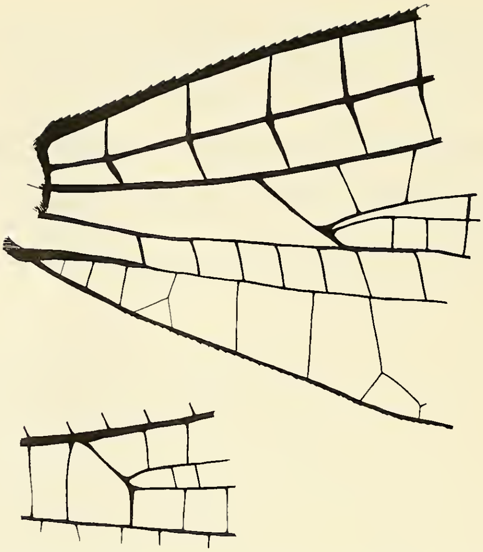
Vestalis luctuosa is a common species on Java, but on Sumatra it is confined to the southernmost part. *V. amoena* Selys, a common species of this genus on Sumatra, was not represented.

Females of *Neurobasis chinensis* and the regional *Vestalis* species are superficially very similar, and are not easy to separate in the field, especially so, since in many specimens of *N. chinensis* the pseudopterostigma is absent. Both genera are most easily distinguishable based on their wing venation. The Arculus is oblique, but not angulated in *Vestalis*, while it is conspicuously angulated in *Neurobasis* (figs. 1 and 2) (Fraser 1933). Besides, *Neurobasis* has cross-veins in the median (basal) space. Both *Vestalis* species can be identified on the coloration of the labium (cf. Schmidt 1934: figs. 19a-b).

Vestalis lugens Selys

Sumatra, Liwa (2), 190 BE, 1 Sep 1984, 2 females; Idem, Liwa (1), 191 AA, 6 Sep 1984, 1 female; Idem, Liwa (2), 191 AB, 7 Sep 1984, 1 female.

See remarks under *V. luctuosa*.



Figs. 1-2. Wing base in Calopterygidae. – 1 (above), *Vestalis amoena*; 2, (below) *Neurobasis chinensis*.

Family Chlorocyphidae

Rhinocypha angusta (Selys, 1853)

Sumatra, Liwa (2), 191 BD, 1 Sep 1984, 1 male.

Common on Sumatra, but absent from Java.

Rhinocypha selysi Krüger, 1898

Sumatra, Liwa (2), 191 BC, 1 Sep 1984, 1 male.

Species confined to Sumatra (contra Lieftinck 1934, cf. Lieftinck 1954). Generally a rare species, except in southern Sumatra. In the RMNH collection 18 males and 13 females are represented. Most specimens are from the Gn Tanggamus area and Benkulen; the other sites are (from north to south): Deli, Bolimbingan, 600 m (leg. Straatman) [locality not found]; Emmahaven, Padang [1°00'S 100°22'E] (leg. Van der Starre); Sandaran Agung (Kurintji) [= probably Sanggaran agung, Kerintji; 2°08'S 101°31'E] (leg. Jacobson).

Family Euphaeidae

Euphaea variegata (Rambur, 1842)

Sumatra, Liwa (2), 191 BA, 1 Sep 1984, 1 male.

Java, Ujung Kulon, Cidaon, 190 HC, 15 Sep 1984, 1 female.

Widespread and common on Sumatra and Java; recorded as 'very common' from the S. Lampoeng Residency by Lieftinck (1935). It was also found on Panaitan Island (Lieftinck 1953).

Family Coenagrionidae

Agriocnemis femina (Brauer, 1868) (figs. 9-11)
Sumatra, Liwa (1), 191 AA, 6 Sep 1984, 1 female.

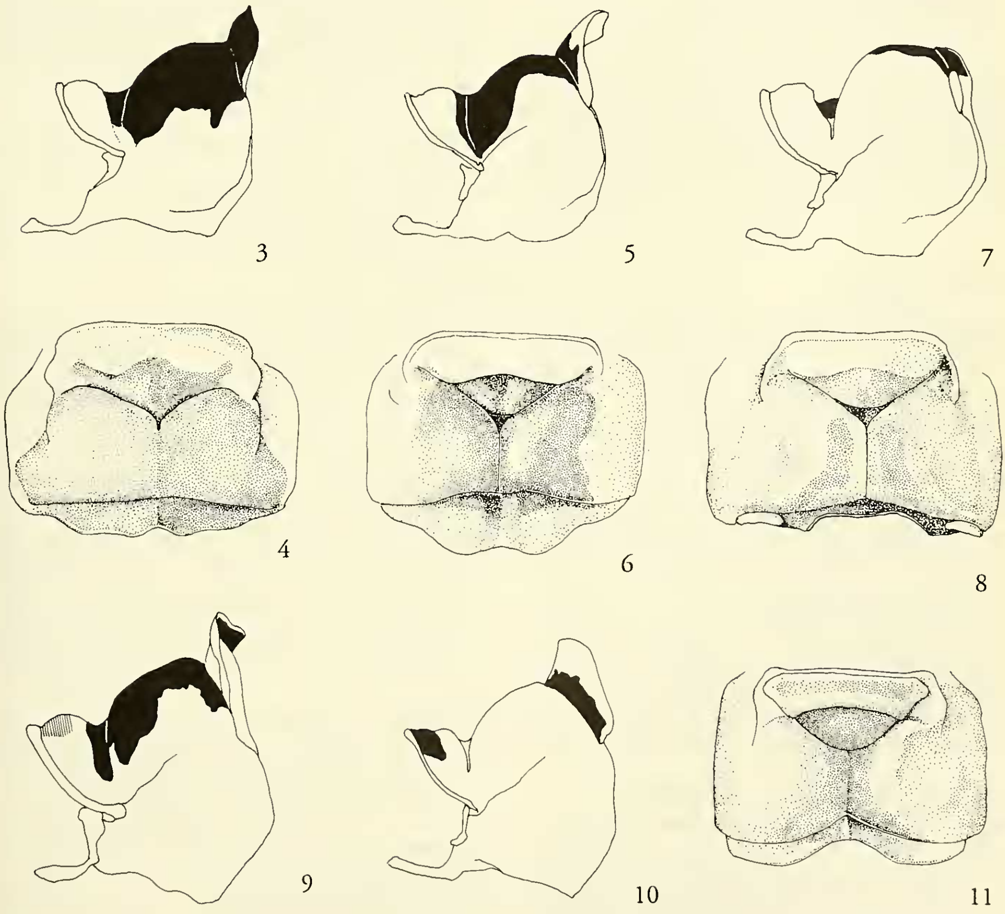
Eurytopic species, very common and widespread from Bengal, Assam (Fraser 1933) eastwards to northern Australia. See further notes under *A. pygmaea.*

* **Agriocnemis pygmaea** (Rambur, 1842) (figs. 5-8)
Krakatau Is. – Anak Krakatau, 215.DE, 21 Aug 1985, 1 female [short-lobed form, headless].

New to the Krakataus. Habitat: all kinds of stagnant waters. Presumably a wind-borne species (Lieftinck 1954). Very widespread, and usually very common in the afrotropical, oriental and australian region.

The females of *Agriocnemis* are not easy to distinguish, since both *A. femina* and *A. pygmaea* are polytypic. In this area also another species, *A. minima* Selys (figs. 3-4), has to be taken into account. I have now provisionally examined material available in the RMNH collection (figs. 3-11). It seems that at least two forms of both species based on the shape of the prothorax, can be recognized. Females of *A. pygmaea* may have a strongly developed hindlobe with a median depression, or the hindlobe is nearly completely lacking (figs. 5-8). Apart from these structural forms, there also exist two colour forms, an orange-red and a greenish-brown form. Therefore, as already stressed by Ris (1916), four forms can be recognized, since differently shaped hindlobes of the pronotum occur in both colour forms.

According to Ris (1916), *Agriocnemis femina*



Figs. 3-11. Prothorax in females of *Agriocnemis*, left lateral and dorsal view. – 3-4, *A. minima*, Java; 5-6, *A. pygmaea* long-lobed form from Sulawesi; 7-8, *A. pygmaea*, short-lobed form from Ceylon; 9, *A. femina*, form with medially depressed hind lobe, northern Borneo; 10-11, *A. femina*, form with upright hind lobe, Sumatra.

falls apart in at least four structurally different forms. Also the males of this species show geographical variation. Females of *A. femina* always have a well-developed hindlobe, but it is strongly upright in specimens from Ceylon, or it is conspicuously depressed in the middle in more eastern populations (figs. 9-11). According to Lieftinck (1954: 72 footnote) two well definable subspecies occur on Sumatra.

Family Platycnemididae

Coeliccia membranipes membranipes (Rambur, 1842)

Sumatra, Liwa (1), 191 AA, 6 Sep 1984, 1 female.

Common species on Java and Sumatra in slowly flowing waters.

Family Aeshnidae

Gynacantha basiguttata Selys, 1882

Java, Ujung Kulon, 190 AG, 17 Sep 1984, 1 male.

Considered as 'rare' on Java by Lieftinck (1934); more common on Sumatra, and also known from Billiton, Simalur, Enggano and western Borneo (collection RMNH). Apparently not rare on Panaitan Island (Lieftinck 1953). Breeds in forest pools. The adults fly only at dusk, as all *Gynacantha* species.

Family Libellulidae

Agrionoptera insignis insignis (Rambur, 1842)

Java, Ujung Kulon, Pulau Peucang, 15 July 1984, 190 AD, 1 male; Idem, 190 AF, AK, AP, AR, Sep 1984, 1 male 3 females; Idem, 190 AC, 20 Sep 1984, 1 female; Java, Ujung Kulon, Cibunar, 190 GB, Sep 1984, 1 male; Java, Ujung Kulon, P. Peucang, 24.1, 22 Sep 1984, 1 female.

Confined to the coastal area of a significant part of the oriental region. Locally abundant in e.g. mangrove forests. It breeds in shady pools in forests (Lieftinck 1954). Although it was once 'one of the commonest, and certainly the most striking' (Lieftinck 1934) dragonfly of the Krakataus, it was not collected there during this expedition, nor by Yukawa & Yamane (1985). The collection made in 1908 by Jacobson (Ris 1912) consisted of this species and *Diplacodes trivialis* (Rambur, 1842) only.

Cratilla lineata assidua (Lieftinck, 1953)

Java, Ujung Kulon, Pulau Peucang, 11 Sep 1984, 1 male.

A woodland species, obviously uncommon on Java. The nominotypical subspecies occurs widely on Sumatra and was once collected on the Krakatau islands, while subspecies *assidua* Lieftinck was recorded from Panaitan Island (Lieftinck 1953).

Lathrecista asiatica (Fabricius, 1798)

Java, Ujung Kulon, Pulau Peucang, 190 AJ, 13 Sep 1984, 1 male.

Although widespread in the oriental region, Lieftinck (1954) considered it uncommon on Java.

Lyriothemis magnificata (Selys, 1878)

Java, Ujung Kulon, Pulau Peucang, 190 AQ, 3 Sep 1984, 1 female.

A rare species from Sumatra, Billiton and Java. Unknown from western Java according to Lieftinck (1934), but in the RMNH collection several specimens from this area are available, e.g. Udjung Kulon, Tjibunar [river], 28 Nov 1958, 1 female.

Orthetrum sabina (Drury, 1770)

Sumatra, Liwa (1), white light, 190 AC, 31 Aug 1984, 1 female; Idem, Liwa (2), 191 BE, 1 Sep 1984, 1 male.

Java, Ujung Kulon, Pulau Peucang, 190 AN, 17 Sep 1984, 1 male; Idem, Carita, 310 A, 11 Aug 1985, 1 female. Widespread and common species; abundant in cultivated areas. Collected on the Krakataus by Yukawa & Yamane (1985).

* **Orthetrum testaceum testaceum** (Burmeister, 1839)

Sumatra, Liwa (2), 191 BA and 191 BC, 1 Sep 1984, 2 males; Sumatra, Liwa (4), 191 DA, 7 Sep 1984, 1 male.

Krakatau Is., Penjang, 3 Sep 1984, 192 BA, 1 male.

New to the Krakatau Islands. Common in the lowlands of Java and Sumatra, and also known from Panaitan Island (Lieftinck 1953). Breeding in all kind of waters (Lieftinck 1934).

* **Diplacodes trivialis** (Rambur, 1842)

Sumatra, Liwa (1), 191 AA, 6 Sep 1984, 1 female.

Krakatau Is, Anak Krakatau, 192 AA, 13 Sep 1984, 1 female; Krakatau Is., Anak Krakatau, 310B; 15 Aug 1985, 1 female; Idem, 310 C, 17 Aug 1985, 1 male; Krakatau Is., Rakata, Owl Bay, 310 F, G and H, 26 Aug 1985, 1 male 2 females.

Very common and widespread species. Recorded from the Krakataus since 1908.

Neurothemis fluctuans (Fabricius, 1793)

Sumatra, Liwa (4), 191 DB, 7 Sep 1984, 3 males 1 female; Idem, 191 DC, same date, 2 males.

See remarks under the following species.

Neurothemis fluctuans (Fabricius, 1793) / **N. ramburii** (Brauer, 1866)

Java, Ujung Kulon, Pulau Peucang, 190 AQ, Sep 1984, 1 male; Idem, 190 AH, Sep 1984, 1 female (homeochrome); Idem, (no number), 11 Sep 1984, 1 female (homeochrome); Idem, 190 AI, 11 Sep 1984, 1 female (homeochrome); Idem, 190 AL, 13

Sep 1984, 1 male; Idem, 190 AE, 15 Sep 1984, 1 female (heterochrome); Idem, 24.1, 22 Sep 1984, 1 female (heterochrome); Ujung Kulon, 190 GA, 20 Sep 1984, 1 female (heterochrome).

According to Lieftinck (1954) *Neurothemis fluctuans* is rare and extremely local on Java, while *Neurothemis ramburii* is widespread but very local there.

I am unable to identify the specimens from Ujung Kulon; the specimens from Sumatra seem to belong to *N. fluctuans*. It is well known that identification of the genus *Neurothemis* meets many problems in this part of their range. Lieftinck (1954: 151 footnote) mentions hybridization between *N. fluctuans*, *N. ramburi* and *N. terminata*, three species frequently flying on the same site. Lieftinck (1953) records all three species from Panaitan Island, and according to Lieftinck (1954) they can usually be kept apart fairly easily. I have examined large series in the RMNH collection, all identified by Lieftinck, but relevant characters seem to show significant variation between populations. A further study of this complex is needed to judge on the status of these taxa. Also Ris (1911: 567) has expressed his doubts about the specific status of these taxa. An extensive study of the variation of the characters involved (e. g. size of wing marking, number of cubito-anal cross-veins) could contribute to our understanding of the historical biogeography of this species complex.

Neurothemis terminata Ris, 1911

Java, Ujung Kulon, hills behind Carita, 11 Aug 1985, 1 male; Idem, Cidaon, 190 HB, 15 Sep 1984, 1 male.

A common species on Java. See also remarks under *N. fluctuans / N. ramburii.*

* **Neurothemis tullia feralis** (Burmeister, 1839)

Krakatau Is., Anak Krakatau, outer rim, Malaise trap 21-24 Aug 1985, 213 EA, 1 male.

Second species known from Anak Krakatau, and only the second record of this species from the Krakataus (first record: Rakata, 23 Oct 1923). It is rather rare and local on Java (Lieftinck 1934); there are no reliable records from Sumatra. It inhabits marshlands and weedy ponds.

* **Rhyothemis phyllis phyllis** (Sulzer, 1776)

Krakatau Is., Panjang, 192 BB, 3 Sep 1984, 1 male.

Rather common species on Java, probably also breeding in oligohaline waters. The present record is the first of this species from Panjang, and only the second record for the Krakatau islands (first record: Rakata, 1921).

Table 1. Odonata on the Krakatau islands.

	Rakata Besar		Rakata Kecil		Sertung		Anak Krakatau	
Species	Before	Now	Before	Now	Before	Now	Before	Now
Coenagrionidae								
Pseudagrion microcephalum					●			
Ischnura senegalensis	●				●			
Agriocnemis femina			●					
Agriocnemis pymaea								●
Libellulidae								
Agrionoptera insignis	●				●			
Cratilla lineata	●							
Raphismia bispina					●			
Acisoma panorpoides	●							
Orthetrum sabina					●			
Orthetrum glaucum					●			
Orthetrum testaceum				●				
Diplacodes trivialis	●	●	●		●		●	●
Crocothemis servilia	●		●		●			
Neurothemis terminata	●		●		●			
Neurothemis tullia	●							●
Pantala flavescens	●				●	●		
Rhyothemis phyllis	●			●				
Tramea limbata euryale					●			
Macrodiplax cora					●			
Aeshnidae								
Anax guttatus					●			
Total number of species	10	1	4	2	13	1	1	3

Camacinia gigantea (Brauer, 1867)

Java, Ujung Kulon, Pulau Peucang, 190 AM, 18 Sep 1984, 1 female.

Widespread from Burma and Assam eastwards to Eastern New Guinea. Usually rather uncommon, restricted to low altitudes in non-cultivated areas.

* **Pantala flavescens** (Fabricius, 1798)

Krakatau Is., Sertung Spit, at camp, 310 D, 18 Aug 1985, 1 male; Idem, Sertung forest, 310 E, 19 Aug 1985, 1 male.

A very common circumtropical species and strong flier.

DISCUSSION

The dragonfly fauna of the Krakataus is only a poor representation of the fauna of the 'mainlands' of Java and Sumatra. This can even be demonstrated with the present data, but especially when all data available about the fauna of Java and Sumatra, or even those about that of Panaitan Island, are compared with those from the Krakataus.

The reason for the high turnover rate of the species involved must be the fact that there is hardly any water available as breeding site for freshwater invertebrates. Most specimens collected should be considered as stragglers from Java or Sumatra, and must have reached the Krakataus by active flight or transported by the wind. The fauna of Panaitan Island (c. 150 km^2, c. 10 km from the mainland of Java) was found to be far more mature in 1951 and also included several stream-dwelling species. Lieftinck (1953) concluded that the dragonfly fauna of that island was not entirely composed of species that had reached the island accidentally, but that certain species must have inhabited it since the time it was a part of Java. Not all species found on the Krakatau islands (table 1) were also collected on Sumatra and Java by the present expeditions. However, they are all are eurytopic or inhabiting coastal biotopes, where they are common, and usually also abundant, in southern Sumatra and/or western Java (based on Lieftinck 1954).

Nevertheless, in future one may expect an indigenous dragonfly fauna on the Krakataus when the forests have become more mature. Several highly specialized species of Zygoptera as well as Anisoptera, are known as breeders in phytotelmata, e.g. treeholes of decaying logs, bamboo stumps, or waterholes at the leaf-base of *Pandanus* (cf. Corbet 1983). Examples of this fauna are the members of the libelluline genus *Lyriothemis* Brauer (cf. Lieftinck 1954, Kitching 1986), which breed in water-filled treeholes, and the pseudagrionine genus *Amphicnemis* Selys, supposed to breed in water at the leaf-bases of *Pandanus* trees. This kind of Odonata may find a breeding site on the Krakataus in due time. It may even be true that representatives of this kind of dragonflies already inhabit the Krakataus, since most of them are very hard to collect by their inconspicuous behaviour.

From a zoologeographical point of view it is of interest to mention that the fauna of the Krakataus seems to be Sumatran rather than Javan, contrary to the Panaitan Island.

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